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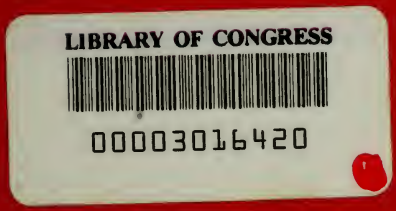

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THE AUTHOR'S SON
Reared from birth on milk pasteurized and modified in the home

Milk and Milk Products in the Home

A Book Intended for Students in Home Economics and for Housekeepers in General

BY

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PREFACE

The cow has been properly called the foster mother of the human race. Her products, in importance, overshadow those from any other source. Through all the centuries, from ancient times to the present, milk and milk products have constituted an important part of the human dietary. In modern times the use of milk has become especially important because thousands of babies are forced to rely upon it as their only source of food.

Good milk is an economical and easily digestible food, and so are many of the products made from it. To impress this fact upon housekeepers and students in home economics has been one of the aims of this book. There is also need of better familiarizing consumers with the various grades of market milk and milk products and to show their uses and value in the dietary.

Unfortunately a great deal of milk placed upon the market is unsafe as a food because of ignorance and carelessness in the methods employed in its production and handling. That milk is often a dangerous food is amply attested by the hundreds of babies which it destroys annually, and by the numerous milk-borne epidemics of contagious diseases such as tuberculosis, typhoid fever, diphtheria etc.—diseases which not only affect babies and children but people of all ages. Special efforts have

therefore been made in this book to outline simple, practical home methods of treating and handling milk by which it is made a safe food for babies and adults.

For many years part of the author's time has been given to teaching dairy subjects to students in home economics. The experience thus gained has been of material value in several ways: it has impressed upon him the conviction that the average housekeeper knows far too little of the relation which milk bears to the welfare of the family; it has also materially assisted him in so arranging and treating the subject matter as to make the book especially adaptable as a text for students in home economics.

JOHN MICHELS

June 1, 1915.

THE COW is the foster mother of the human race. From the day of the ancient Hindoo to this time have the thoughts of men turned to this kindly and beneficent creature as one of the chief sustaining forces of human life.

W. D. HOARD

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CHAPTER I

COMPOSITION OF MILK

Cow's milk has an average composition as follows:

Water	87.2 per cent.
Casein	2.8 per cent.
Albumen	0.6 per cent.
Milk sugar	4.9 per cent.
Butterfat	3.8 per cent.
Ash	0.7 per cent.
Enzymes	Trace
	100.0 per cent.

The term "per cent." applied to the constituents of milk means pounds in 100 pounds. Thus, 3.0 per cent. of casein means that there are three pounds of casein in a hundred pounds of milk.

In speaking of milk, the terms "four per cent. milk," "five per cent. milk," etc., are frequently used, meaning milk containing four and five per cent. butterfat, respectively. Such terms as "whole milk" and "normal milk" are often used in place of the term "milk," but they mean exactly the same thing.

MILK CONSTITUENTS

Water. The water of milk is identically the same as any chemically pure water. While milk is a fluid substance, it contains less water than many common vegetables. Parsnips, string beans and asparagus, for example, contain more water than average market milk.

Casein and Albumen. These substances belong to the group of nutrients known as proteids. They are rich in nitrogen and, like the lean of meat and the white of egg, serve the purpose of building up muscles, hair and tendons, and may also supply heat and energy.

Casein is a white, insoluble substance suspended in milk in an extremely finely divided condition. It is the most important tissue building constituent of milk and forms the basis of an almost endless variety of cheese. The curdling of milk is due to the casein, which is easily precipitated by acids. Thus, in the ordinary souring of milk enough acid is eventually produced to curdle (coagulate) it. Rennet extract also curdles the casein and, therefore, the milk of which the casein is a part.

Albumen is a soluble substance which is not affected by rennet or acids but curdles when heated to 170° F. In composition it very closely resembles casein, differing from it chiefly in being rich in sulphur while the casein is rich phosphorous.

Milk Sugar. This constituent, unlike the casein and albumen, contains no nitrogen. It belongs to the group of nutrients known as carbohydrates, whose purpose in nutrition is to supply heat and energy and to store reserve energy in the form of fat. As a source of energy, carbohydrates are equal to proteids, pound for pound.

Milk sugar, which is known chemically as lactose, has the same composition as cane sugar; it differs from this, however, in being more digestible and

only faintly sweet. When milk sours part of the sugar is changed into lactic acid through the agency of bacteria, which are described on page 19.

Butterfat. This substance belongs to the third great group of nutrients known as fats, which contain the same chemical elements as the carbohydrates but in different proportions. As a food, one pound of fat is equal to two and one-fourth pounds of carbohydrates. Fats play the same part in nutrition as the carbohydrates, supplying heat and energy and storing surplus energy in the form of fat.

Butterfat is a compound fat, being made up of at least nine distinct fats. The most important of these fats is butyrin, which is present in no vegetable or other animal fats. Butyrin is volatile and has a very pleasing aroma.

Figure 1 shows the appearance of butterfat when viewed in milk under a high power microscope. It

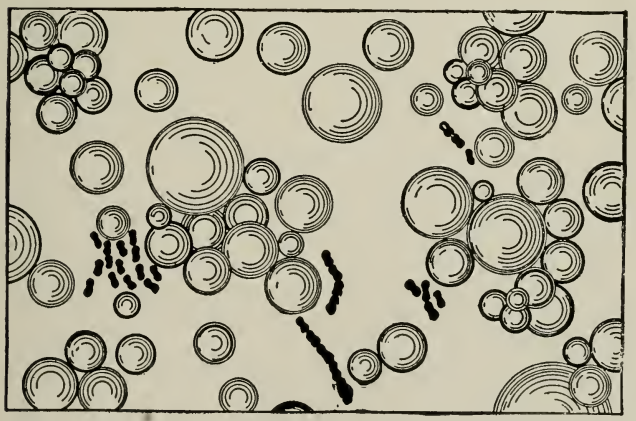

Figure 1—Butterfat globules in milk. Dark spots are bacteria—some in chains (Russell)

is suspended in the form of extremely small globules numbering about 100,000,000 per drop of milk. It is this fine division of the butterfat, together with its large percentage of soluble fats, which, to a large extent, accounts for its superior digestibility. Another matter which aids in the digestion of butterfat is its low melting point. Butterfat melts at about 90° F. while other common animal fats melt at considerably higher temperatures.

Ash. This is the mineral portion of milk and exists mostly in solution. It is composed of lime, magnesia, potash, soda, prosphoric acid, chlorine, sulphuric acid and iron. Its chief purpose in nutrition is to build up bones, teeth and blood.

Enzymes. These are chemical ferments which aid in digestion. It has been shown by experiments that ordinary foods when taken in conjunction with milk are better digested than when taken without the milk. The greater digestibility so found is credited to the digestive ferments contributed by the milk. One of the objections to boiling milk is the destruction of its enzymes by the high temperature.

Milk Solids. The milk solids, sometimes spoken of as "total solids," include all of the milk but the water. If a sample of milk be kept at the boiling temperature until all the water has been evaporated, the dry, solid residue constitutes the solids of milk. The solids less the fat are known as the "solid not fat" or the "non fatty" solids.

CHAPTER II

MILK AS A FOOD

As shown in the preceding chapter, milk is a complete food, containing all the elements necessary to sustain life; moreover, it contains these elements in proper proportions and in easily digestible and assimilable form. Milk is also greatly valued for its palatability.

It is these valuable qualities which have made milk so prominent in the diet of all classes of people. For growing children, milk has no satisfactory substitute; for thousands of babies deprived of their mother's milk, it is indispensable.

Milk is rich in proteids and mineral matter, materials required in building up muscles and bones. This is why milk is so essential for normal growth and body development in children.

Unfortunately too many consumers look upon milk as a luxury. As a matter of fact, at prevailing prices, milk is a cheap food, especially when compared with eggs and meat. One quart of good milk is equal to about eight eggs or three-fourths of a pound of steak.

Variations in Quality. Wide variations exist at present in the quality of market milks. Analyses of normal market milks show a variation in fat content of from 3 to 5.5 per cent. And there is a great deal of milk sold illegally containing only 2.5 per cent. butterfat.

Particularly wide are the variations in the quality of milk from individual cows as shown by the following maximum and minimum composition:

	Per Cent.	
	Maximum	Minimum
Water	90.69	80.32
Butterfat	6.47	1.67
Casein	4.23	1.79
Albumen	1.44	.25
Sugar	6.03	2.11
Ash	1.21	.35

Quality as Affected by Breeds. The quality of milk differs markedly with different breeds of cattle. Some breeds produce rich milk, others relatively poor milk, as shown by the following table:

BREED	BUTTER-FAT	CASEIN	ALBUMEN	MILK SUGAR	ASH
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Ayrshire	3.8	2.5	0.55	4.9	0.70
Guernsey	5.4	2.9	0.60	5.0	0.75
Jersey	5.7	3.0	0.60	5.0	0.75
Holstein	3.4	2.4	0.50	4.8	0.65

With the wide variations existing in the quality of milk it should be paid for according to its quality. It is fair to say that, in point of food value, a quart of milk containing 5.5 per cent. butterfat is worth at least fifty per cent. more than a quart containing only 3 per cent. butterfat. In other words, when a consumer pays twelve cents a quart for 5.5 per cent. milk, he is paying no more for the actual amount of food he gets than when he pays eight cents a quart for 3 per cent. milk.

It is as much a business proposition for consumers to consider the food value of milk as it is for them to consider the quality of the cloth they buy.

Value of Clean, Wholesome Milk. The real value of milk cannot be judged entirely from its composition. For babies especially, cleanliness and purity should chiefly determine the price to pay for milk. With milk as with many other commodities, the best is the cheapest in the long run. It costs more to produce clean milk than just common milk and consumers must expect to pay for the extra expense involved in furnishing clean, wholesome milk.

Various Uses. Milk is used in so many different ways that it is difficult to see how any family can get along without it. Its use in custards, puddings, cakes, cookies, muffins, bread, biscuits, gravies, soups, chowders and scores of other ways, makes milk well-nigh indispensable. It is not the province of this book to discuss the uses of milk in cooking because this information can be obtained from nearly all cook books.

CHAPTER III

PHYSICAL PROPERTIES OF MILK AND CREAM

Specific Gravity. By specific gravity is meant the weight of one substance compared with that of another. Water is taken as a standard for comparison and its specific gravity is 1. Milk has an average specific gravity of 1.032, being slightly heavier than water. A vessel holding 1,000 pounds of water would hold 1,032 pounds of milk.

To find the weight of a gallon of milk multiply the weight of a standard gallon of water (8.35 lbs.) by the specific gravity of milk. Thus 8.35x1.032=8.62 pounds, the weight of a gallon of milk.

Cream is lighter than milk because its chief constituent is butterfat, which has a specific gravity of only 0.9. Hence the richer the cream the lighter it is. Cream containing 20 per cent. butterfat has a specific gravity of about 1.01.

Viscosity. This refers to the adhesiveness or stickiness of milk and cream. Milk is more viscous than water, and cream is still more viscous than milk.

Viscosity is an important property to consider in connection with cream. In fresh, warm cream the viscosity is considerably less than in old, cold cream of the same richness. A fresh, warm cream may therefore appear to be lacking in richness when in reality it is lacking in viscosity. For the same reason fresh, warm cream is difficult to whip. Age and

low temperature are about as important as the richness of the cream in getting cream to whip satisfactorily.

When cream is heated to high temperatures, its viscosity is lessened even when subsequently cooled to a low temperature. This is due, in part at least, to the fact that the heating destroys the soluble lime, because the viscosity can be restored by adding lime in a soluble form. Lime will increase the viscosity of any cream, whether heated or not, and hence will make it appear richer than it actually is. For this reason a great deal of commercial cream has lime added to it. The quantity required is so small, however, that it will escape detection, even by experts.

Acidity. Fresh milk when tested by the usual alkaline methods, shows an acidity of about 0.14 per cent. When it reaches the consumer the acidity, as a rule, is close to 0.2 per cent. This is important to remember when cow's milk is substituted for breast milk in infant feeding. Breast milk shows no acidity, and for this reason when babies are fed on cow's milk the acidity is first neutralized by the addition of lime water.

Absorbing Powers. Milk is peculiarly susceptible to odors, absorbing them as readily as a sponge absorbs water. The same is true of cream. These products must, therefore, never be exposed to strong odors, not even those of vegetables, fruits, cakes, cheese and the like.

Color. The color of milk varies with the breed of cattle and with the character of the feed. Holstein-Friesian milk has a white color, while that of Jerseys is a light yellow. Guernsey milk has the rich-

est color of any breed, being a deep yellow. When cattle feed on pasture or other green feed the color of the milk becomes more yellow. For these reasons the color of milk is not a reliable indication of richness.

Carotin is the substance which gives milk its natural color.

CHAPTER IV

COMMON MILK BACTERIA

What Bacteria Are. The term bacteria is applied to the smallest of living plants, which can be seen only under the highest powers of the microscope. Each of these plants is made up of a single cell. They are so small that 30,000 of them laid side by side will measure only about an inch. Their presence is almost universal, being found in the air, water, soil, milk, decaying matter, etc. In everyday language bacteria are usually spoken of as **germs.**

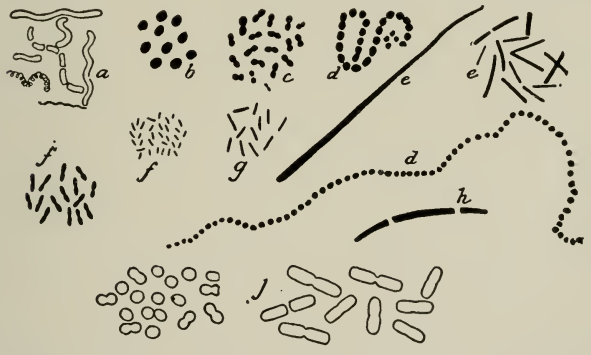

Figure 2—Different shapes of bacteria (Lehmann & Neumann)

Rapidity of Growth. Under favorable conditions bacteria grow with marvelous rapidity, some reproducing themselves a million times in twenty-four hours. The majority of bacteria require for best growth a warm, moist and nutritious medium such as milk, in which an exceedingly varied and active life is possible.

Most bacteria grow rapidly at temperatures between 60° and 100° F.; some are capable of multiplying at freezing temperatures, while others grow best at temperatures approximating 120° F.

Beneficial and Injurious Bacteria. A great many species of bacteria are entirely harmless and some are decidedly beneficial. Other kinds produce undesirable flavors. Most dangerous and harmful of all are those bacteria which cause diseases like typhoid fever, diphtheria, scarlet fever, etc.

Lactic Acid Bacteria—Beneficial. These are by far the most common of all the bacteria found in

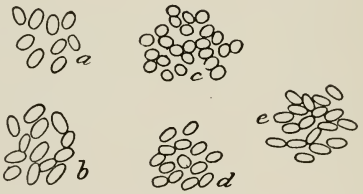

Figure 3—Varieties of lactic acid bacteria (Conn)

milk. The souring of milk and cream is due to these bacteria. They act upon the milk sugar, changing part of it into lactic acid, which gives milk its sour taste. When the acidity of milk reaches about 0.9 per cent., the lactic acid bacteria are either checked or killed by the acid they have produced, and the formation of acid ceases. In ordinary sour milk, about half of the milk sugar is left unchanged.

Under cleanly conditions, the lactic acid type of bacteria always predominates in milk. When, however, milk is drawn under uncleanly conditions, the lactic acid organisms are often outnumbered by

other kinds resulting in the production of tainted milk.

The fine flavor of butter and that of many varieties of cheese, is due to the lactic acid bacteria. The tonic value of good sour milk is also due to these bacteria. In the famous experiments of Dr. Metchinkoff, it was established that the lactic acid organisms exert favorable effects in the large intestine by destroying and combatting obnoxious kinds which are always present there. Because of their antagonistic properties, the lactic acid bacteria act as a real safe-guard to milk, suppressing undesirable kinds capable of producing bad flavors, toxins, etc.

Undesirable Bacteria. To this class belong the butyric acid bacteria, which are the chief cause of rancid butter; putrefactive bacteria, which decompose milk and cream; bitter, slimy, gassy, toxic, and many other kinds of bacteria which need not be discussed here.

Most of the undesirable bacteria find their way into milk through particles of dust, manure, hair, flies, bits of hay, chaff, straw, etc. A single fly or hair may carry half a million bacteria; and while flies and hair may be strained out of milk, the bacteria cannot, because of their extreme smallness.

Occasionally milk becomes infected with disease producing bacteria. This class of bacteria will be discussed in another chapter.

Spores. These are inactive bacteria which can resist high temperatures to a remarkable extent, some being able to endure a boiling temperature for many

minutes. Under favorable conditions, spores soon develop into active bacteria, in which condition they are readily destroyed by heat.

Lactic acid bacteria do not produce spores, but putrefactive and other undesirable bacteria do. In heating milk, therefore, the lactic acid bacteria are destroyed first, and the spores left undestroyed will later grow and develop undesirable flavors in the milk. This is the reason why **pasteurized** milk (see page 37) will usually develop putrid odors with age, rather than sour as is the case with unheated milk.

Numbers of Bacteria in Milk. Ordinary market milk literally teems with bacterial life, averaging about half a million bacteria per teaspoonful of milk. Such large numbers are not necessarily harmful to adults but they may seriously affect babies and young children. It is known that the prevalence of bowel trouble among children under two years of age is largely due to the consumption of milk containing large numbers of putrefactive and allied species of bacteria.

CHAPTER V

CARE OF MILK IN THE HOME

No matter how good the condition of the milk when delivered, if carelessly handled in the home it will keep sweet but a very short time. To keep milk and cream sweet and pure, they must be kept cold and clean. As soon as the milk is delivered, it should be put in a cool place—a clean refrigerator if possible. The vessels in which the milk and cream are kept must be sterile and covered. Vessels are not sterile unless they have been kept in boiling water for five minutes and then inverted upon a clean shelf without wiping.

Importance of Low Temperature. Milk always contains bacteria no matter how cleanly the conditions under which it is produced. At ordinary temperatures these bacteria increase with marvelous rapidity; at low temperatures their growth practically ceases. The effect of temperature on bacterial development is graphically shown in Figure 4:

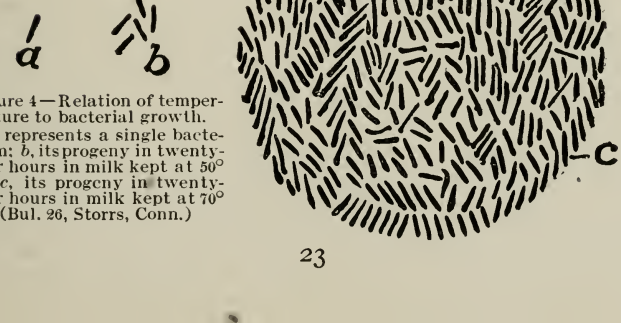

Figure 4—Relation of temperature to bacterial growth. *a*, represents a single bacterium; *b*, its progeny in twenty-four hours in milk kept at 50° F.; *c*, its progeny in twenty-four hours in milk kept at 70° F. (Bul. 26, Storrs, Conn.)

At a temperature of 50° F. the bacteria multiplied five times; at 70° F. they multiplied seven hundred and fifty times.

Roughly speaking, at 98° F. bacteria multiply at least one hundred times faster than at 70° F. At 32° F. bacterial development practically ceases.

Milk or cream may be kept sweet a long time at 40° to 45° F. because the lactic acid bacteria practically stop growing at these temperatures. But there are other classes of bacteria that can grow at these temperatures as evidenced by the production of undesirable flavors. Such flavors usually become noticeable after thirty-six hours.

Air and Water Cooling. Milk should always be cooled to as low a temperature as possible by placing the receptacle containing it in cold water. Air cooling, such as would take place in a refrigerator, is very much slower than water cooling and for this reason milk and cream should always be cooled as much as possible with cold water before placing them in the refrigerator.

The reason why air cools so much more slowly than water at the same temperature is the fact that air is a much poorer conductor of heat and cold than is water.

Importance of Cleanliness. Nowhere does cleanliness count for so much as in the handling of milk. If a refrigerator is used, it should have a thorough cleaning at least once a week. Always see to it that the milk is put into clean, sterile vessels. Milk dishes may look perfectly clean but, unless they have been scalded or boiled, they may contain thousands of bacteria.

Especially important is it to give close attention to the baby's bottles. As soon as the baby has finished his meal, the bottle and nipple should be rinsed with warm water (not hot), then washed in hot water containing some washing powder, like sal soda, and then scalded. Under no conditions should nipples be used which are joined to the feeding bottle by means of a rubber tube. Such tubes cannot be thoroughly cleaned.

General Handling of Milk. All milk and cream should be pasteurized (see page 41) in the home, even if they have been previously pasteurized by the dealer. Modification of milk for baby feeding is also important. Both of these subjects are fully treated in separate chapters.

The mistake is sometimes made in warming the entire twenty-four hours' allowance of milk for the baby and then using from this the amount required for a single feeding. Repeatedly warming and cooling milk will quickly spoil it. Only the amount required for immediate use should be taken from the main supply and the latter should be kept cold until ready to use.

Always take milk into the house as soon as delivered, especially in hot weather. If this cannot be done, provide an insulated box into which the milkman may put the bottle.

On account of their great absorbent properties, milk and cream must be kept in covered vessels, especially when placed in the kitchen or cellar, or possibly in the refrigerator with fruits and vege-

tables. Aside from absorbing odors when exposed in these places, they will also take up bacteria which will shorten their keeping quality.

Pour milk from one vessel to another as little as possible to avoid contamination; and do not add new milk to old milk; neither add warm milk to cold.

The tops of the bottles should always be washed before removing any milk. They are more or less contaminated with dust during transportation and also become soiled from the hands.

Always clean the bottles before returning them.

CHAPTER VI

MARKET CLASSES OF MILK

In most country towns and villages only one grade of milk is sold. This is ordinary, raw milk containing from 3 to 5 per cent. butterfat.

In the larger cities, in addition to ordinary milk, other classes are sold such as certified, modified, evaporated, condensed, guaranteed, sanitary, pasteurized, inspected, grades A, B and C, and dip or bulk milk.

Certified Milk. Certified milk is the highest grade of market milk and is produced under conditions im-

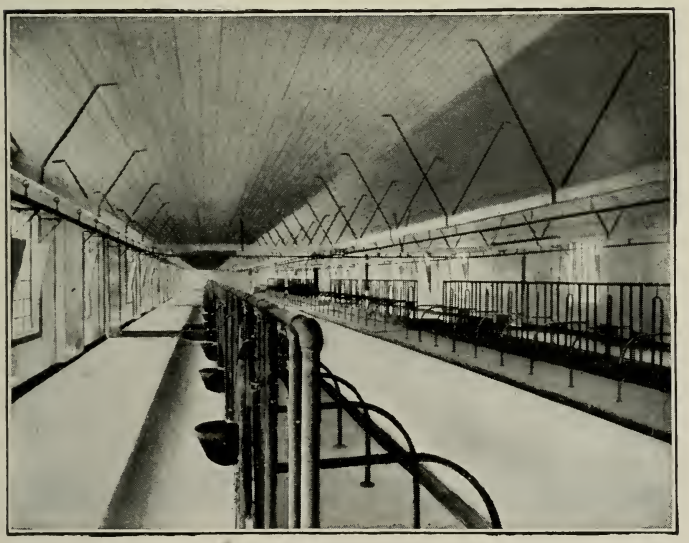

Figure 5—Sanitary Dairy Barn

posed by medical milk commissions, which usually employ a veterinarian, a bacteriologist and a chemist to look after the production of the milk. It must come from healthy cows, be free from disease germs and preservatives, must have a known chemical composition, and must be so produced and handled as to insure a minimum number of bacteria. If the producer has complied with all the requirements, he is furnished a certificate by the commission which permits him to use the "certified" label on his products.

The cows, milkers and premises are regularly inspected, and the milk is regularly subjected to chemical and bacteriological tests. The number of bacteria permitted by different commissions varies from 10,000 to 30,000 per cubic centimeter* of milk; and the butterfat content ranges from about 3.5 to 4.5 per cent.

The milk bottles are sealed and bear the date of bottling and the name of the commission. Delivery should be made within twenty-four hours after the milk is drawn and its temperature during this time should not exceed 45° F.

The term "certified milk" is registered in the United States patent office and its use is legally permitted only on milk approved by medical milk commissions.

Certified milk is now largely used for infants and invalids. There is, however, also a rapidly increasing use made of this milk by the better informed people who are not satisfied with the condition of average market milk.

*A cubic centimeter (C. C.) is equal to about 25 drops.

Modified Milk. See page 44.

Evaporated Milk. See page 54.

Condensed Milk. See page 53.

Guaranteed Milk. This is milk which is guaranteed by the retailer to come up to certain requirements, which vary in different localities. As a rule it contains a certain minimum of butterfat such as 4 per cent. or 5 per cent. To this may be added a guarantee that the milk is from non-tubercular cows.

Sanitary Milk. Milk of this class is guaranteed as to certain high class sanitary conditions under which it is produced and handled.

Pasteurized Milk. See page 37.

Inspected Milk. This class of milk as a rule is produced under conditions requiring a high degree of cleanliness and cows which the tuberculin test has shown to be free from tuberculosis. These conditions are certified to by responsible inspectors.

Grades A, B and C Milk. In New York state milk is graded according to its sanitary condition, the score card used being that shown on pages 97 and 98. Grade A requires a minimum score of 75, grade B 60, and grade C 40.

Bulk or Dip Milk. The old method of hauling milk to the city in five, eight or ten gallon cans and removing each customer's allowance by means of a dipper or faucet, has been found so objectionable that the practice has been largely abandoned. The principal objections to this method are: (1) The admission of dust and bacteria to the milk while measuring it; (2) the use of unsterilized milk vessels by consumers; (3) exposure of the vessels to dust while

on the steps of the consumer; (4) the use of unclean vessels by milkmen in measuring each customer's share ; (5) lack of uniformity in the milk, especially if removed from the cans by means of a faucet, in which case the first drawn milk is likely to be lowest in fat content; and (6) the possibility of drivers tampering with the milk.

JUDGING MILK AND CREAM

In judging milk and cream a score card like the following is generally used:

Item	Perfect Score	Score Allowed	Remarks
Bacteria	35		Bacteria found per cubic centimeter
Flavor and odor	25		Flavor Odor
Visible dirt	10		
Butterfat	10		Per cent. found
Solids not fat	10		Per cent. found
Acidity	5		Per cent. found
Bottle and cap	5		Cap Bottle
Total	100		

EXPLANATION OF SCORE CARD

Bacteria. The maximum number of bacteria permissible per cubic centimeter for a perfect score on bacteria as a rule is 400. Numbers beyond this point will detract from the score until 200,000 is reached when the score is zero. Deductions from the perfect score are made uniform, being proportional to the bacteria count between 400 and 200,000.

A bacteria count as low as 400 per c.c. is possible, though difficult to attain. By exercising proper cleanliness and thoroughly cooling milk, the majority of dairymen can keep the bacteria count below 10,000 per c.c. A low bacteria count is largely a matter of cleanliness and low temperature.

Flavor and Odor. Flavor refers to taste and odor to the aroma detectable by the nose. It is impossible to describe a perfect flavor and odor. Anything in the least objectionable to the taste or smell will detract from the score. Under this head, weedy, stable, manure, bitter, rancid and unclean flavors or odors are most common. To obtain a perfect score for flavor and odor, perfect cleanliness must prevail, the milk must be kept free from odoriferous surroundings, and feeding must be done after milking, especially when silage or other odoriferous feeds are fed.

Visible Dirt. Any sediment, however slight, in the bottom of the bottle will detract from the score. Most milk will show visible dirt if produced under uncleanly conditions. Dust, particles of dirt, hair or particles of litter, and sometimes all of these, are noticeable in the bottom of bottled milk.

The greatest factor in reducing dirt to a minimum is washing the cow's flanks and udder just previous to milking. The moist condition prevents the dislodgement of dirt. Another great aid in obtaining clean milk is the covered milk pail.

Butterfat. To obtain a perfect score on butterfat, milk as a rule must contain not less than 4.0 per

cent. For each tenth below 4.0 per cent., 0.2 point is deducted from the perfect score till 3.5 per cent. is reached. A whole point is deducted for every tenth below 3.5 per cent. Milk with a butterfat content less than 2.7 per cent. or less than the legal local limit, is scored zero for butterfat.

Cream is usually scored perfect for butterfat when its fat content is 20 per cent. or above.

Solids Not Fat. Usually 8.7 per cent. or more is required for a perfect score on solids not fat. For each tenth per cent. below 8.7 one point is deducted. Milk containing less than 7.8 per cent. or less than the legal limit, is scored zero for solids not fat.

Solids not fat are not considered in cream.

Acidity. The limit of acidity for a perfect score is 0.2 per cent. When milk is thoroughly cooled there is little difficulty in keeping the acidity below this limit.

Bottle and Cap. The following defects detract from the perfect score for bottle and cap: Partially filled bottle, tinted glass, leaky caps, improperly paraffined caps, unprotected caps and anything that in any way detracts from the appearance of the package.

CHAPTER VII

MILK-BORNE DISEASE BACTERIA

Every consumer of milk should know that milk is frequently a carrier of bacteria which belong to the strictly disease-producing kind. Records show that numerous epidemics of typhoid fever, diphtheria, septic sore throat trouble and scarlet fever. have been caused by infected milk supplies. Perhaps one of the most menacing of all milk-borne disease bacteria is the tubercle bacillus.

Fortunately in recent years great efforts have been made to safeguard milk supplies against these destructive disease-producing bacteria, and much has been accomplished in this direction. It is comforting to know also that every consumer can make his milk supply absolutely safe against any disease bacteria by treating the milk as recommended in the next chapter on Pasteurization of Milk and Cream.

Figure 6—Tuberculosis bacilli (Lehmann & Neumann)

Tuberculosis. It is well known that one of the most common disease bacteria found in raw milk is the bovine (cow) tubercle bacillus. Examination of milk supplies throughout the country reveal the presence of this bacillus in milk to an alarming extent. Frequently as many as 10 to 15 per cent. of the samples of milk examined show the presence of the tubercle organism. Indeed the prevalence of tuberculosis among cattle makes it positively unsafe to assume that the milk of any herd of cows is free from tubercle bacilli, unless the cows have been actually shown to be free from this disease by the tuberculin test.

The question naturally arises: To what extent can tubercle bacilli from cows cause tuberculosis in man? The answer is graphically set forth in the following table which presents the results of an ex-

TABLE SHOWING PROPORTION OF TUBERCULOSIS OF HUMAN AND BOVINE ORIGIN IN PATIENTS EXAMINED

Diagnosis	Adults 16 Years and Over		Children 5 to 16 Years.		Children Under 5 Years.	
	Human	Bovine	Human	Bovine	Human	Bovine
Pulmonary tuberculosis	778	3	14	—	35	1
Tuberculous adenitis, cervical	36	1	36	22	15	24
Abdominal tuberculosis	16	4	8	9	10	14
Generalized tuberculosis, alimentary origin	6	1	3	4	17	15
Generalized tuberculosis	29	—	5	1	74	7
Generalized tuberculosis including meninges alimentary origin	—	—	1	—	5	10
Generalized tuberculosis including meninges	5	—	10	—	76	1
Tuberbular meningitis	1	—	3	—	28	4
Tuberculosis of bones and joints	32	1	41	3	27	—
Tuberculosis of skin	10	3	4	6	2	—

haustive study of the subject by Park and Krumweide and numerous foreign investigators. The table was prepared by Park and Krumweide of New York City. It not only shows different forms of tuberculosis in man, but also compares the number of cases due to human and bovine tubercle bacilli.

The table shows that children are especially liable to infection with bovine tubercle bacilli. It is reported that of the total number of deaths of young children from tuberculosis, about 10 per cent. are from bovine infection.

Epidemics Caused by Infected Milk. Over five hundred epidemics of common diseases caused by infected milk supplies are on record. The milk sup-

Figure 7—Typhoid bacilli (Lehmann & Neumann)

ply becomes infected with the disease germs of some person suffering from the disease. The infection may take place in many different ways which it is not necessary to discuss here. Typhoid infection is sometimes caused by persons known as "typhoid carriers," who are not actually sick but heavily infected with the disease bacteria. In the following

list of epidemics all infection is of human origin excepting septic sore throat trouble, which is now believed to be caused not only by milk infected with bacteria from human beings but also by cows suffering from diseased udders.

Septic Sore Throat. Dr. C. E. North reports the following epidemics:

Boston,	1,043	cases caused by one raw milk supply
Boston,	227	" " " " " " "
Chicago,	10,000	" " " " " " "
Baltimore,	602	" " " " " " "
Cortland-Homer,	669	" " " " " " "

Typhoid Fever. Trask reports 317 outbreaks of which the following are typical cases:

Glasgow,	500	cases caused by one raw milk supply
Cologne,	270	" " " " " " "
Port Jervis,	59	" " " " " " "
Springfield,	182	" " " " " " "
Oakland,	262	" " " " " " "
Montclair,	107	" " " " " " "
Stamford,	307	" " " " " " "

Scarlet Fever. Trask reports 125 epidemics of which a few are given below:

Buffalo,	57	cases caused by one raw milk supply
Washington,	33	" " " " " " "
London,	284	" " " " " " "
Beverly,	6	" " " " " " "
Liverpool,	59	" " " " " " "
Mt. Vernon,	45	" " " " " " "
Boston,	195	" " " " " " "

Diphtheria. Trask reports 51 outbreaks, a few of which are as follows:

Brookline,	12	cases caused by one raw milk supply
Los Angeles,	35	" " " " " " "
Wellsville,	84	" " " " " " "
Clifton,	36	" " " " " " "
Hyde Park,	69	" " " " " " "
Warwick,	64	" " " " " " "

The difficulty of keeping disease-producing bacteria out of milk is so great that occasionally even **certified** milk becomes infected with these organisms.

CHAPTER VIII

PASTEURIZATION OF MILK AND CREAM

Ideal pasteurization consists in heating milk to 145° F. and keeping it at this temperature for 30 minutes, after which it is quickly cooled to 50° F. or below. This treatment will kill all of the strictly disease producing bacteria as well as most of the common bacteria usually found in milk; in other words, pasteurization means killing bacteria.

Necessity for Pasteurizing Milk. On an average every drop of ordinary milk contains about 20,000 bacteria. Some of these bacteria belong to the kind that irritate the intestines of babies and children, causing various forms of bowel trouble. No milk is entirely free from this class of bacteria, but the more cleanly the conditions under which the milk has been produced and handled the smaller the number of bad bacteria it will contain.

In New York City during 1912, 3,392 babies under one year of age died from bowel trouble; nine out of every ten of these were bottle fed. Other cities show similar records. It is the putrefactive and other filth bacteria contained in milk that are responsible for the prevalence of bowel trouble and the high mortality among bottle fed babies and young children.

It is estimated that in the large cities about one-half of the deaths of infants under one year of age result from bowel troubles and that four-fifths of these have been bottle-fed.

It is a matter of common knowledge that the summer following the weaning of breast-fed babies, is usually one of more or less danger to the child. Many mothers expect "summer complaint" at this time as a perfectly natural thing, little realizing that bowel trouble is commonly due to the irritating effect of bacteria contained in the child's milk.

The frequent presence in milk of infectious disease bacteria as discussed in the preceding chapter, furnishes additional reasons for pasteurizing milk. These bacteria are especially to be feared because they not only affect babies and children but are equally dangerous to grown people. So difficult is it to safeguard milk completely against these deadly organisms that even certified milk, in several instances, has been known to contain them.

Since all serious danger from bacteria is removed by the pasteurizing process, it certainly seems nothing less than folly not to pasteurize milk, especially that produced and handled under prevailing conditions.

What has been said here in reference to the need of pasteurizing milk applies with equal force to cream.

Pasteurization by Milk Dealers. To eliminate as far as possible the danger of disease resulting from the consumption of raw milk, great efforts have been made in recent years by public health officials to have milk pasteurized before it is delivered to the consumer. In a number of large cities pasteurization of the ordinary grades of milk has been made com-

pulsory. Very notable improvement has followed this practice. In New York City, for example, where an average of 17,000 babies were fed daily on pasteurized milk during a period of three years, the death rate per 1,000 births decreased from 125 to 94.

Similar results have been secured in many other places. Perhaps the most significant results following the pasteurization of milk are those secured at the Infant Asylum at Randall's Island, New York City. The death rate among the babies in this institution during 1895 to 1897 inclusive averaged from 39 to 44 per cent. At this time Mr. Straus secured the establishment of a complete pasteurizing plant on the island and the first year following the pasteurization of the milk the death rate dropped to less than 20 per cent., or less than half what it was before the milk was pasteurized.

Advantages of Pasteurizing in the Home. Unfortunately much milk has been poorly pasteurized in the past, and there is undoubtedly much inefficiently pasteurized milk sold at the present time. It occasionally happens, too, that efficiently pasteurized milk is put into unsterilized bottles, which destroys the value of the pasteurizing process. Milk may also become infected in the interval between pasteurizing and bottling. An instance is cited by Dr. C. E. North in which 85 cases of typhoid fever were traced to milk which had become infected through a "typhoid carrier" whose business it was to cap the bottles.

Another instance is on record where a driver, convalescing from scarlet fever, left a trail of the disease along his route. The driver had a running

sore on his finger and in taking hold of the tops of the bottles infected them with the disease germs.

It is largely for these reasons that the author for years has recommended pasteurizing the milk in the home. Moreover, when the milk is pasteurized in the home, there are advantages in buying raw rather than pasteurized milk. Under ordinary conditions, for example, raw milk will not keep long, and for this reason must be sold shortly after it is produced. Pasteurized milk, on the other hand, is often sold when several days old. In this connection it is to be remembered that old pasteurized milk, especially when kept at rather high temperatures, may be dangerous to babies and young children. Under such conditions the bacterial spores, which are not destroyed by the pasteurizing process, develop into enormous numbers and may cause very serious bowel disturbances. For this reason when pasteurized milk is purchased, it is desirable to repasteurize it in the home. Another advantage in buying raw milk is the fact that the conditions under which milk has been

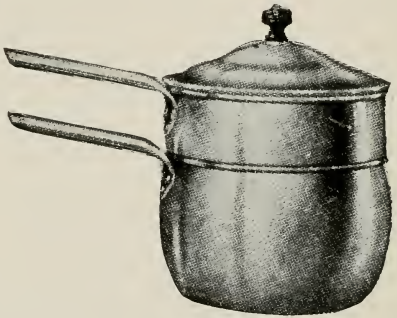

Figure 8—Double boiler (Cooker)

produced can always be told better in raw than in pasteurized milk.

Home Process of Pasteurization. A common two-quart double boiler, like that shown in Figure 8, furnishes the best means of pasteurizing milk and cream in the home. Put a few inches of water in the outer vessel; then rinse the inner one with boiling water and pour the quart of milk into it. Now heat the milk to 145° F. and keep it at this tempera-

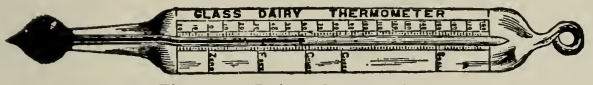

Figure 9—Dairy thermometer

ture for thirty minutes using a dairy thermometer to note the temperature.

The thermometer should not be removed from the milk until the heating is completed. It is also necessary to stir the milk frequently during the heating to prevent a "skin" forming at the surface. If a spoon is used to stir the milk, this should also be kept in the milk until the pasteurizing is completed.

As soon as the heating is finished, the milk should be promptly cooled to as near 45° F. as possible. The lower the temperature the better the milk will keep. During the cooling the milk is kept in the same vessel in which it was heated. By changing the water several times in the outer vessel the temperature of the milk is quickly reduced. After cooling, the milk may be put into sterilized bottles or it may be kept in the boiler, care being taken to keep the receptacles well covered.

The reason why milk should be kept near 145° F. during pasteurization is the fact that, at tempera-

tures somewhat lower than this, the bacteria will not be destroyed, while at higher temperatures undesirable changes take place in the milk. An exposure of a few minutes at 165° F. will affect the taste of milk, begin to curdle the albumen, and will also affect the enzymes present in milk. It is important, therefore, that milk intended for baby feeding be kept at 145° F. as closely as possible during the pasteurizing process.

Milk intended for adults need not be watched so carefully, and no particular harm will result from heating such milk to 165° F. The changes taking place at this temperature, however, would impair its digestibility too much for baby feeding.

In pasteurizing milk, the higher the temperature the shorter the time required to kill the bacteria. Thus, a temperature of 160° F. maintained for ten minutes will prove quite as effective in destroying bacteria as 145° maintained for thirty minutes.

There are other methods employed in pasteurizing milk in the home such as pasteurizing in the original bottle or transferring the milk to smaller bottles for baby feeding; and good results may be obtained with these methods. However, the author's experience in pasteurizing milk in the home during the last fifteen years has convinced him that for the average family the double boiler will give the best results.

Inefficient Pasteurization. Milk that has been underheated is more dangerous than that which has not been heated at all. The reason for this is that

inadequate heat in pasteurizing may destroy the lactic acid bacteria (which are easily killed) and by so doing actually better the conditions for the growth of the more resistant and obnoxious kinds. Lactic acid organisms are antagonistic to other classes of bacteria and are therefore a real safeguard to milk. This makes it plain that unless milk is pasteurized at a temperature which will destroy the pathogenic and non-acid bacteria as well as the acid bacteria, it is far better not to heat it at all.

Digestibility of Pasteurized Milk. The success which has attended the feeding of pasteurized milk to thousands of babies is convincing proof that the digestibility of milk is not impaired by the pasteurizing process.

The remarkable results obtained by Straus in his charitable dispensations of pasteurized milk to thousands of babies in New York City early proved the high value of this class of milk. Later in the City of New York where, during three years, an average of 17,000 babies were daily fed on pasteurized milk, the digestibility and food value were found equal to those of raw milk. In all this work no trouble from rickets or scurvy was encountered.

It is more than probable that the earlier objections to pasteurized milk for baby feeding were due to faulty methods of pasteurization. It is generally admitted, however, that for some babies pasteurized milk is slightly more constipating than raw milk. This objection is insignificant when compared with the advantages gained by the pasteurizing process.

CHAPTER IX
MODIFIED MILK

Modified milk is cow's milk whose composition has been changed to approximate that of breast milk. It is used as a substitute for breast milk in feeding infants and babies who, for one reason or another, have been deprived of their mother's milk. That there is need of modifying cow's milk for baby feeding will be conceded when the differences between it and breast milk are fully understood.

Breast and Cow's Milk Compared. The average composition of breast and cow's milk is shown in the following table:

	Water	Butter-fat	Casein	Albu-men	Milk Sugar	Ash
	%	%	%	%	%	%
Cow's milk..	87.2	3.8	2.8	0.6	4.9	0.7
Breast milk .	88.2	3.4	0.6	0.5	7.1	0.2

The chief difference between the two milks, it will be noted, is in the casein content, which is nearly five times as great in cow's milk as in breast milk. Furthermore, the casein of cow's milk has an acid reaction while that of breast milk is practically neutral. The acid condition of the casein, together with the lactic acid present in cow's milk, causes the latter to clot when taken into the stomach. The clotting of milk has little significance with adults or children with strong digestion, but there are

thousands of babies who cannot digest these clots and hence suffer from colic and other discomforts.

To adapt cow's milk to baby feeding, therefore, requires that it be changed, not only to prevent the formation of clots in the stomach but also to rid it of the excess of casein which causes an unnecessary tax upon the digestive system. This is accomplished by diluting milk with water.

Figure 10—Apparatus and materials used in modifying milk. Left to right is quart of milk, cream dipper, pint of milk, viscogen, milk sugar, oat water, thermometer and double boiler

Amount of Water to Add. The amount of water to be added to milk must be gauged largely by the total proteids in milk, which are about three times greater in cow's than in breast milk. It must also partly be determined by the age of the child.

Infants and children, like young animals, require changed rations with advancing age. Thus in some of the laboratories where milk is modified on a large scale, the percentages vary as follows:

Age of Child	Butterfat	Sugar	Protein
	Per Cent.	Per Cent.	Per Cent.
One week	2.00	4.50	0.75
Four weeks	3.00	6.00	1.00
Seven weeks	3.50	6.50	1.25
Fourteen weeks	3.50	6.50	1.25
Twenty weeks	3.75	6.50	1.50
Thirty weeks	4.00	6.50	1.75

Where naturally rich milk is used or milk that has been enriched by the addition of cream, one part of milk to two and a half to three parts of water is about right for infants under one week old. After this the water is gradually reduced so that at the end of the sixth week water and milk are used in practically equal proportions. Beginning with the twentieth week, one part of water to two of milk will be about right. At the age of one year the child may be given plain, unchanged cow's milk.

Adding Milk Sugar. Cow's milk is naturally deficient in milk sugar when used for baby feeding. This deficiency is materially increased by the water added to reduce the proteids. Hence the necessity of adding commercial milk sugar (lactose). Under normal conditions about an ounce must be added daily to the child's ration.

Milk sugar is preferable to ordinary (cane) sugar because it is more digestible. In case of severe constipation, maltose (malt sugar) may be used to advantage in place of milk sugar because it is more laxative.

Reducing Acidity. Fresh cow's milk shows an acidity of about 0.14 per cent.; this amount is usually increased to almost 0.2 per cent. by the time it reaches the consumer. Breast milk is practically neutral, that is, shows no acidity.

To reduce the acidity of cow's milk, lime water is added. This is best used in the form of viscogen, which is sucrate of lime (see page 67). One tablespoonful of viscogen to a quart of modified milk is usually sufficient. This amount is equivalent to about ten tablespoonfuls of ordinary (U. S. P.) lime water such as is commonly bought in drug stores.

Viscogen is recommended here because of its cheapness. Its cost is less than one-twentieth that of commercial lime water. Viscogen cannot be bought but must be prepared in the home as directed on page 67.

Oatmeal Water. After the child is a month old it will be found advantageous to use oatmeal water in place of plain water for diluting the milk. The oatmeal water is prepared by adding a tablespoonful of rolled oats to a pint of water and boiling the mixture for at least thirty minutes. Then strain through several thicknesses of cheese cloth.

The use of oatmeal water in place of plain water in diluting milk is especially recommended for babies troubled with constipation. It is laxative and also contributes valuable food material. The strength of the oatmeal water may be doubled after the child is four or five months old.

Barley flour and similar materials are often used in place of rolled oats, but these are too expensive

for the average home and have, in most cases, no particular advantage over oatmeal water for normal babies.

Adding Cream. Where average market milk is used, a small amount of cream is necessary in modifying milk. An extra pint of milk is generally purchased from which to obtain this cream. The milk is allowed to stand undisturbed for at least an hour and then about two ounces of cream are removed by means of a conical dipper like that shown in Figure 10. This amount of cream supplies the deficiency in butterfat.

Summary. The following table presents a summary of approximate proportions of materials used in modifying milk for babies at different ages:

Table showing daily allowance of Feed at Different Ages

Age of Baby	Average Market Milk	Cream from Top of Extra Pint of Milk	Water	Oatmeal Water	Viscogen (Home-made Lime-water)	Milk Sugar
	Ounces	Ounces	Ounces	Ounces	Ounces	Ounces
First Week.....	4	1	12	..	$\frac{1}{6}$	1
Second Week....	5	$1\frac{1}{2}$	10	..	$\frac{1}{5}$	1
Third Week ...	7	$1\frac{1}{2}$	10	..	$\frac{1}{5}$	1
Fourth Week...	8	2	10	..	$\frac{1}{4}$	1
Second Month ..	10	2	..	12	$\frac{1}{4}$	1
Third Month....	12	2	..	12	$\frac{1}{4}$	1
Fourth Month ..	16	2	..	12	$\frac{1}{3}$	1
Fifth Month ...	18	2	..	12	$\frac{1}{3}$	1
Sixth Month ...	20	2	..	10	$\frac{1}{3}$	1
Seventh Month..	22	2	..	10	$\frac{1}{3}$	1
Eighth Month ..	24	2	..	8	$\frac{1}{4}$	1
Ninth Month	26	1	..	8	$\frac{1}{4}$	1
Tenth Month....	28	1	..	5	$\frac{1}{6}$	$\frac{3}{4}$
Eleventh Month	30	1	..	5	$\frac{1}{8}$	$\frac{1}{2}$
Twelfth Month..	32	..	..	..	..	..

In case common drug store lime water is used in place of viscogen, the amount must be about ten times as great. In other words, one-fifth ounce of viscogen contains as much lime, and therefore has the same effect, as two ounces of common lime water.

Requirements Vary. All babies cannot use the same ration. Some require more food and some less than that given in the preceding table. The proportion of materials used also varies. Some babies require more butterfat, others may be benefited by more milk sugar. Others again may require less of these materials. The extent of dilution with water may be advantageously decreased in some cases and increased in others. Lime has a constipating tendency and may have to be reduced in some cases. The baby must be closely watched to learn its requirements.

How to Feed. During the first five months, babies should be fed about every three hours during the day and once during the night. After the fifth month, the interval between feedings may be increased to three and one-half and four hours and the night feeding omitted.

The allowance at a feeding averages about two ounces the first week, three ounces the second and third weeks, three and one-half to four ounces from the third to tenth week. After this time the allowance is gradually increased so that at the ninth month about eight ounces are used at a feeding.

The manner of feeding discussed here may have to be modified somewhat according as the child is weak or strong.

The Value of Whey. In ordinary baby feeding when the first signs of digestive disturbances appear

Figure 11—From right to left is quart of milk, rennet tablets, whey from quart of milk, curd from quart of milk

it is important to reduce the quantity or the quality of the milk, or both, to relieve the strain on the digestive system. In cases, however, where babies are suffering from severe attacks of indigestion or other sickness, they are usually materially benefited by temporarily substituting whey for the modified milk. Whey is largely composed of milk sugar and albumen, the two soluble constituents of milk. It is a light food, very easily digested.

For method of preparing whey see page 63.

Herd Milk Preferred. Herd milk on account of its greater uniformity, is always preferred to milk from single cows. Not only does the quality of milk from individual cows fluctuate greatly from day to

day, but it also increases in richness with the advance of the period of lactation. In herd milk these daily variations are less the larger the herd. Moreover, dairymen retailing milk from herds, have cows freshen at different periods so as to maintain a uniform supply of milk throughout the year, thus minimizing the effects from the advancing period of lactation.

Goat's Milk. Milk from single goats has the same objections as that from single cows. Such milk must be modified the same as cow's milk. Indeed, in spite of the claims made for goat's milk, there is no better substitute for breast milk than cow's milk.

Other Substitutes. Where cow's milk cannot be obtained, sweetened condensed and evaporated milks may be used. But there are various objections to this class of milk for which the reader is referred to chapter X.

Various proprietary foods are in extensive use, but according to the eminent baby feeding specialist, Dr. L. E. Holt, these are less satisfactory than any of the other substitutes for breast milk that have been considered.

How to Keep Modified Milk. As soon as the milk is pasteurized, it should be put into sterile bottles. Some prefer to put the milk directly into the nursing bottles, each holding enough milk for one feed. But the simplest method is to put the milk into two pint bottles and then pour the milk from these into the nursing bottle as required. Small nursing bottles are difficult to clean and for this reason the fewer in use the better.

In all cases the milk should be covered and stored at a low temperature in a clean place.

Warming the Milk. Without exception the milk should be warmed before feeding. This is best accomplished by surrounding the nursing bottle containing the baby's feed with warm water. Frequently where haste is made to warm the milk quickly, the bottle is surrounded with hot water (150° F. or above). This, however, has the same bad effect as pasteurizing milk at these temperatures. The milk which comes in contact with the glass has practically the same temperature as the surrounding water and this portion may be entirely overheated when the mixture is only moderately warm.

All milk should be fed at blood temperature, or 98° F.

CHAPTER X

CONDENSED AND EVAPORATED MILKS

Sweetened condensed and evaporated milks are made as a rule from a good quality of cow's milk. The bulk of this class of milk is retailed in hermetically sealed tin cans holding six or more ounces of milk. The greatest field of usefulness for milk of this kind is in sections where it is difficult to obtain fresh milk.

Sweetened Condensed Milk. In the manufacture of this class of milk, about two and one-half to two and three-fourths pounds of fresh milk are required to make one pound of condensed milk. The condensation is accomplished in vacuo, that is, under reduced atmospheric pressure. In this way the natural boiling temperature is reduced to a point where the moisture can be driven off at a relatively low temperature. It is only at the beginning of the condensing process that the milk is exposed, for a short time, to a high temperature. This results in the destruction of most of the bacteria present in the milk. It also renders insoluble part of the mineral matter, especially the lime.

Condensed milk is not sterile, however, its preservation being effected by the addition of large quantities of cane sugar (sucrose). About 40 per cent. of condensed milk is cane sugar. The syrupy condition produced by the sugar stops ordinary bacterial growth.

The addition of large quantities of sugar reduces the digestibility of the milk because cane sugar is not as easily digested as the constituents of fresh milk. The cane sugar also unbalances condensed milk as a food, making it rich in carbohydrates and relatively poor in proteids. In this connection it will be remembered that fresh cow's milk is a well balanced food.

Sweetened condensed milk has an average composition as follows:

Water	26.5 per cent.
Butterfat	9.0 per cent.
Proteids	8.5 per cent.
Milk sugar	13.3 per cent.
Cane sugar	40.9 per cent.
Ash	1.8 per cent.
	100.0

Evaporated Milk. This is unsweetened condensed milk, preserved by sterilization under steam pressure. From two to two and one-half pounds of fresh milk are required to make one pound of evaporated milk.

The high temperature required to render the milk sterile produces changes in the milk constituents. Part of the milk sugar is oxidized or caramelized, giving the milk a light brown color. Most of the albumen is rendered insoluble. Usually most of the casein is precipitated but the precipitate is again broken up by vigorous shaking in the process of manufacture. A large portion of the ash is rendered insoluble, the lime often appearing in the bottom of the can in the form of insoluble granules. The

enzymes or digestive ferments are also destroyed by the sterilizing process.

The average composition of evaporated milk is as follows:

Water	73.0 per cent.
Butterfat	8.3 per cent.
Proteids	7.5 per cent.
Milk sugar	9.7 per cent.
Ash	1.5 per cent.

CHAPTER XI

SOUR MILK

In discussing the use of sour milk, it should be remembered that the souring is due to the lactic acid bacteria which are always present in milk. These bacteria, besides souring milk, antagonize most of the common milk bacteria, especially the putrefactive kinds. They are also known to be antagonistic to many disease producing bacteria. Sour milk is, therefore, commonly looked upon as having antiseptic properties, and, because of this, it is extensively recommended as a tonic or health drink. It is now sold to the trade under various names such as buttermilk, cultured milk, Bulgara, Pokolac, Bacillac, Fermillac, Vitalac, Yoghurt, Zoulac, etc. Some of these preparations are made from partially skimmed milk.

Medical Value. It was Dr. Metchnikoff of the Pasteur Institute who first proclaimed the full virtues of sour milk, especially that soured with the Bacillus Bulgaricus, which is the name applied to a species of lactic acid bacteria indigenous to Bulgaria where Metchnikoff found people to live to an unusually old age. Investigation proved to him that the regular indulgence in a drink, Yoghurt, containing this bacillus, was largely responsible for the good health and longevity of Bulgarians. Metchnikoff demonstrated that the Bulgarian and other lactic acid bacteria are antagonistic to putrefactive

and allied organisms and that, by virtue of this, when taken into the system, will check putrefaction in the intestines and thus prevent the formation of toxic substances, which give rise to a retinue of intestinal and bodily disorders. The antiseptic value of sour milk is believed by Metchnikoff to be the means of prolonging life to a very appreciable extent.

Dr. North's report on the antiseptic value of lactic acid bacteria in the treatment of certain diseases, says that these bacteria as a wash or spray on inflamed surfaces or cavities often diminish the discharge upon such surfaces or cavities; that they often diminish odors caused by putrefaction; and that they sometimes appear to check both acute and chronic inflammations caused by infections.

Undoubtedly in many cases where favorable results have been obtained from the use of sour milk, the acid itself has been of much value. Indeed, it is well known that the acid of sour milk has very beneficial effects in certain stomach disturbances. Sour milk is frequently fed to babies suffering from chronic or acute indigestion.

As to the antiseptic value of sour milk, it has been shown experimentally that dangerous disease bacteria, like those causing typhoid fever, are killed as a rule in about four days when placed in sour milk.

Natural Buttermilk. Most butter is made from sour cream, and the buttermilk, which is a by-

product of butter manufacture, is therefore naturally sour. When butter is made from clean flavored sour cream, the buttermilk has practically the same tonic or medicinal value as other commercial forms of sour milk. As a rule, however, natural buttermilk is inferior to these, both in flavor and in the quantity of desirable bacteria it contains. The lactic acid bacteria die off very rapidly in sour milk, and, since natural buttermilk is usually older when sold than other commercial forms, it naturally contains fewer of these bacteria.

Ordinary Sour Milk and Skimmilk. It is well known that good, natural buttermilk has a peculiar flavor which is highly relished by most people and which is different from that of ordinary sour milk or sour skimmilk. When, however, ordinary sour curdled milk or skimmilk is churned or agitated the same as is cream in making butter, it will assume the characteristic flavor of natural buttermilk. The churning process incorporates air and thoroughly breaks up the curd clots, resulting in a smooth, thick liquid which cannot be distinguished from ordinary good buttermilk.

A reasonably good buttermilk or sour milk for drinking may, therefore, be made by allowing milk or skimmilk to curdle thoroughly and then breaking up the curd by vigorous agitation. The more butterfat the milk contains, the greater the palatability and food value of the sour milk made from it.

Ideal Sour Milk for Drinking. As has already been pointed out, ordinary milk contains many kinds of bacteria,—good, bad and indifferent. To get the

best sour milk, therefore, it is necessary to destroy the bacteria in the milk by pasteurization and then to add lactic acid bacteria in pure form in which they are generally spoken of as pure cultures of lactic acid bacteria. These cultures cost about 50 cents per bottle and can be made to last about a month.

Method of Using Cultures of Lactic Acid Bacteria. Pasteurize a quart of milk at about 165° F.

Figure 12—Cultures of lactic acid bacteria

for thirty minutes. Cool to about 80° F. Then add bottle of lactic acid bacteria, stir well and set aside at room temperature to sour. When thoroughly curdled, which usually requires twenty-four hours, pasteurize another quart of milk, cool to 80° F. as before, and then add a few tablespoonfuls of the curdled milk and allow to sour at room temperature. In fact the second bottle of sour milk is made just like the first except that, in place of the bottle of culture, a few tablespoonfuls of the curdled milk are added to sour it. A third bottle is prepared

from the second, and so on, as long as the flavor remains good. When bad flavors appear, a new bottle of culture must be purchased. It will be noted from this that the process of propagating lactic acid cultures is somewhat similar to propagating yeast for bread making.

As soon as the newly pasteurized milk has been inoculated with the curdled milk, the balance of the curdled milk is then vigorously shaken in the bottle until the curd is sufficiently broken up to make it suitable for drinking. The best possible sour milk obtainable is prepared in this way, and the richer the milk the more palatable it will naturally be.

By adding a bottle of sour milk prepared in this way to cream used for buttermaking or to skimmilk for cottage cheese making, the flavor of the butter and cheese will be greatly improved.

Advantages of Milk Soured in the Home. There are several important advantages in preparing sour milk in the home in the manner described above. In the first place the sour milk can be used in prime condition, which is immediately after it has curdled. At this time it has the mildest degree of acidity and also contains the largest number of lactic acid bacteria.

In this connection it will be remembered that soon after curdling, the lactic acid bacteria die off very rapidly, and the older the sour milk the fewer of these bacteria it will contain. The highest tonic or medicinal value of sour milk is therefore obtained when used immediately after it has curdled. If kept

at low temperatures (below 50° F.) sour milk may be kept in good condition for a considerable time.

Preparing sour milk in the home also has all the advantages described under "Advantages of Pasteurizing in the Home," page 39.

Value of Cleanliness. To obtain the best sour milk and to assist in propagating the lactic acid bacteria in pure form, requires that all bottles and vessels with which the milk comes in contact be thoroughly sterilized with scalding or boiling water before using. Cleanliness and thorough pasteurization are the secrets in obtaining fine flavored sour milk.

Buttermilk Tablets. Various kinds of buttermilk tablets are found on the market which consist of small quantities of cultures of lactic acid bacteria in compressed form. These act much more slowly than the cultures obtained in bottles previously described. Otherwise they act in the same manner. It is intended that each bottle of sour milk be prepared with a new tablet.

CHAPTER XII

WHEY, SKIMMILK AND COTTAGE CHEESE

WHEY

Whey is the by-product of the manufacture of cheese. It is the liquid part of milk obtained by curdling the milk with rennet extract and then breaking up the curd and applying heat for a short time.

Composition. Fresh whey made from sweet milk has the following average composition:

Water	92.84 per cent.
Milk sugar	5.00 per cent.
Albumen	0.70 per cent.
Casein	0.20 per cent.
Butterfat	0.40 per cent.
Lactic acid	0.16 per cent.
Ash	0.70 per cent.
	100.00

Food Value. From the composition it is seen that whey contains about the same percentage of milk sugar, albumen and ash as milk, but the butterfat and casein have been largely removed. Whey has approximately half the food value of milk. With most of the insoluble casein removed, whey constitutes a light food, extremely easy of digestion. It is, therefore, especially valuable as a substitute for milk in feeding babies suffering from indigestion and during general illness. It is equally valuable for children and adults suffering from digestive disturbances.

Preparation of Whey. Whey is prepared as follows: Heat a quart of milk to about 90° F.; add one junket tablet, dissolved in cold water, or about five drops of rennet extract or rennin; mix vigorously for a moment and then let stand quietly to curdle. When well curdled, slice the curd into pieces about the size of a hickory nut and then pasteurize the same as milk, stirring the curd during first five minutes of heating and occasionally thereafter. Strain while hot through several thicknesses of cheese cloth, and bottle. Keep the whey cold and use it unmodified.

Making Rich Whey. In making whey the chief purpose is to get rid of the casein, which is hardest to digest. But in the ordinary process described above, most of the butterfat is incidently eliminated with the casein.

More of the butterfat can be retained in the whey by mixing the curdling agent (rennet extract) with the milk while cold (45° to 55° F.) and keeping the milk cold a number of hours. The rennet extract scarcely acts in cold milk and the cream is therefore free to rise and will continue rising as long as the milk is kept cold. If the milk is warmed later to the usual curdling temperature without disturbing it, practically all of the cream which has risen on it will pass into the whey. As much as one-half of the original butterfat in the milk can be worked into the whey by keeping the milk cold several hours.

SKIMMILK

This is milk from which the cream has been removed. It is essentially the milk less the butterfat

as will be seen from the following average composition:

Water	90.50 per cent.
Butterfat	0.10 per cent.
Milk sugar	4.95 per cent.
Casein	3.15 per cent.
Albumen	0.52 per cent.
Ash	0.78 per cent.
	100.00

From the composition it is seen that skimmilk has essentially the same proteid and mineral content as milk, and therefore has practically the same muscle and bone building value. Its total food value, however, is only about one-half that of milk.

COTTAGE CHEESE

Food Value. Cottage cheese is made from skimmilk and consists chiefly of casein and water. It is therefore a proteid food like beef steak, with which it compares favorably in food value. When moderately soft and moist it ranks as one of the most digestible of foods. The presence of the acid and the large number of lactic acid bacteria in fresh cottage cheese also gives it tonic value similar to that of sour milk. Its composition is as follows:

Water	73.0 per cent.
Proteids	19.0 per cent.
Sugar and lactic acid	5.5 per cent.
Ash	2.5 per cent.
	100.00

Home Manufacture. Cottage cheese is easily made as follows: Allow skimmilk to sour at room tem-

perature (about 75° F.), and when firmly curdled, heat to about 90° F. and pour the curd into a cheese cloth bag and hang this up to drain. The draining requires a number of hours and should be continued until all free moisture has escaped. When sufficiently drained add a little salt and cream to improve the flavor.

The finest flavored cottage cheese is obtained by adding to the skimmilk a small amount of milk soured with cultures of lactic acid bacteria. See page 59.

Defects in Cottage Cheese. Commercial cottage cheese often has a dry, rubbery texture, or it may be bitter and sour. The former condition is caused by employing too high a temperature in making the cheese, the latter by too much moisture and age.

CHAPTER XIII

CREAM

When milk remains undisturbed the butterfat globules, being light, begin to rise and soon there will be a rich layer over the milk, which is cream. The longer milk stands, within certain limits, the more cream will form at the surface. The limit of creaming is generally reached in twenty-four hours.

Practically all cream sold at the present time is separated instantly from milk by centrifugal force, which is generated in a "cream separator." By means of an adjustment, cream of any richness can be produced with this method of creaming.

Composition. Cream contains all the constituents found in milk, with the butterfat greatly predominating. The following is the composition of a fairly good quality of market cream:

Water	66.41 per cent.
Butterfat	25.72 per cent.
Casein and albumen	3.70 per cent.
Milk sugar	3.54 per cent.
Ash	0.63 per cent.
	100.00

Cream of course is valued for its butterfat, and the price asked for it varies almost directly in proportion to its richness in this constituent. Thus cream containing 40 per cent. butterfat sells for practically double the price of 20 per cent. cream. Market cream varies in richness from 18 to 50 per cent., the great bulk of it containing about 20 per cent. butterfat.

Food Value. Cream is rarely purchased for its food value except when prescribed by a physician for patients requiring a rich and very digestible diet. Being rich in butterfat, it is naturally a very nutritious, but one sided, food. It is rich in heat and energy-forming material and relatively poor in muscle forming elements.

Cream is chiefly used as a relish and in this respect undoubtedly stands without a rival.

Pasteurizing Cream. Cream is pasteurized in precisely the same manner as milk. Moreover, there exists the same necessity for this treatment because cream contains the same kinds of bacteria as the milk from which it has been obtained and in even larger numbers.

One effect of pasteurizing cream is to reduce its body or viscosity; this, however, is largely restored by holding the cream at a low temperature a number of hours after pasteurization. A quick method of restoring the viscosity of pasteurized cream is to treat it with a small quantity of soluble lime. This not only restores the original body or thickness of the cream, but increases it to such an extent that a great deal of cream, both pasteurized and unpasteurized, is fraudulently so treated. It leads the consumer to believe that his cream is richer than it actually is.

Viscogen. The soluble lime which is added to cream is known as viscogen. It consists of lime dissolved in a strong solution of sugar. The method of preparation is as follows: Slake one part of good

quick lime in three parts of water; add this to two and one-half parts of sugar dissolved in five parts

Figure 13—Materials for viscogen. At the left is sugar and water in which it is to be dissolved; at the right is lime and water in which it is to be dissolved

of water. Shake the mixture at intervals for about an hour and then allow to stand quietly for twenty-four hours. The clear liquid which has formed is viscogen. This should be carefully bottled, either with the sediment or without. The sediment consists of undissolved lime. Viscogen will keep for weeks if kept well stoppered in a dark, cold place.

Figure 14—From left to right is sugar solution, slaked lime, viscogen. Note sediment of undissolved lime in bottle of viscogen at right

The purpose of the sugar is to increase the solubility of the lime. Viscogen is about ten times as strong as ordinary lime water prepared without sugar.

Aside from its use in thickening thin cream and in assisting in the whipping of either pasteurized or unpasteurized cream, viscogen is very useful also in modifying milk. See page 47.

Visco-Cream. The amount of viscogen required to restore the original consistency of pasteurized cream is about one part to one hundred and fifty parts of cream, which is equivalent to two-thirds teaspoonful of viscogen to one pint of cream. Cream that has been so treated and sold to the public must be labeled visco-cream. But owing to the difficulty of detecting the small quantity of lime added, a great deal of treated cream is sold as untreated cream.

Homogenized Cream. As previously stated, the addition of lime water (viscogen) to cream materially increases its body, making it look much richer than it actually is. Another method of increasing the body of cream is to force it under high pressure through a special machine which breaks up the fat globules into very minute particles. This process is known as homogenizing. A naturally poor quality of cream can be made to look fairly rich by subjecting it to the homogenizing process. A great deal of market cream is homogenized at the present time.

Whipping Cream. To get cream to whip satisfactorily several important conditions are necessary:

The cream must be fairly rich and slightly acid; it must have been kept cold at least two hours previous to whipping and must have a temperature not exceeding 60° F. during whipping. The richer the cream and the lower the temperature the better it will whip. To secure the necessary acidity, cream should be at least twelve hours old before it is whipped. Cream containing about 30 per cent. butterfat and having a temperature of 50° F. or below, will whip very easily.

The addition of one part of viscogen to about one hundred and fifty parts of cream will materially assist in whipping it, especially if it is poor in butterfat. Cream which has been treated with viscogen will also keep sweet considerably longer than untreated cream.

To avoid too high a temperature during whipping, the cream dish and whipper should be thoroughly cooled before whipping and the whipping should be done in a cool room.

CHAPTER XIV

ICE CREAM

As a Food and Delicacy. Ice cream is one of the most popular of all delicacies and its consumption, in recent years, has reached enormous proportions. When properly made and handled, ice cream is very wholesome and digestible. It also has considerable food value, in which respect it compares favorably with ordinary commercial cream. It furnishes, however, a one-sided diet, being rich in fat and carbohydrates (sugar) and very poor in proteids.

Value of Home Made Ice Cream. A great deal of ice cream sold on the market consists of cheap, inferior material. Much of it is made from old, stale cream and with large amounts of fillers and thickeners like gelatin, corn starch, tapioca, arrow root, gum tragacanth, etc. Frequently ice cream is stored weeks before it is marketed.

There is particular danger in old ice cream because of the possible presence of ptomaine poisons. These poisons are the result of certain bacteria which are capable of growing at freezing temperatures. It is well known that every year many persons are poisoned by eating ice cream and such poisoning is attributable to the use of unsanitary cream and to holding ice cream too long at low temperatures.

It is evident from what has been said that the safest ice cream is that which is made in the home from sweet, pasteurized cream and in which nothing but good cream, sugar and flavoring is used.

Kind of Cream for Ice Cream. Use the best flavored sweet cream containing about 20 per cent. butterfat and pasteurize it. To secure a good bodied ice cream, the cream must be kept cold at least six hours before freezing. This is especially important when cream is pasteurized.

Freezing Process. In making ice cream the object is not only to freeze the material (mix) but to incorporate a certain amount of air. Too much or too little air impairs the body of the finished product.

Starting with cream at a temperature of about 35° F., the time required to freeze ice cream should average about twelve minutes, and to get the best consistency the temperature at the close of the freezing process should be approximately 28° F.

Too quick freezing causes the water to separate from the cream, which results in a granular ice cream. Freezing too slowly reduces the overrun and tends to make the ice cream smeary.

To reduce the temperature of a mass of cream below the freezing point, requires a freezing mixture of a low temperature. Such a mixture is secured by mixing salt and crushed ice in the proportion of one part of salt to about three of ice. The purpose of the salt is to lower the freezing point of the melting ice and to hasten the melting.

To melt one pound of ice at 32° F. into water at the same temperature requires 142 heat units. Rapidly melting ice, therefore, absorbs a large quantity of heat which, in the freezing of cream, is largely extracted from the cream.

The temperature of the ice cream mix when starting the freezer should be as near freezing as possible to prevent churning the cream. The tendency to churn is also lessened by revolving the freezer slowly the first few minutes in freezing.

In packing the freezing mixture around the cream container, fill the freezer about one-third full of finely crushed ice and finish the filling by using salt and ice in the proportion of about one to three. As the ice mixture works down during the freezing process, continue adding more salt and ice as needed.

The freezer should be stopped before the cream becomes too thick, else it will lose some of the air that has been incorporated as well as show a tendency to coarseness in texture. Yield and quality therefore demand that the freezer be stopped while the cream is still a trifle soft.

Vanilla Ice Cream. To make a gallon of finished ice cream, requires about two-thirds of a gallon of cream to which should be added about one pound of sugar, which should be well mixed with the cream and allowed to dissolve before starting the freezer. Next add at the rate of about two-thirds ounce of vanilla extract and freeze.

Chocolate Ice Cream. This can be made by adding chocolate flavor to finished vanilla ice cream. Where a regular batch of chocolate ice cream is made, the chocolate is added before starting to freeze.

Lemon Ice Cream. In making lemon flavored ice cream, use the best paper-wrapped lemons, free from

any signs of decay. Wash the lemons lightly in cold water and grate off the outer, yellowish portion of the rind, being careful not to grate off any of the white portion, which is very bitter. Mix the grated rind with sugar, using one ounce of sugar for each lemon rind. Next cut the lemons in two and squeeze out the juice, removing any seeds that may have dropped in from the squeezer. Mix the juice with the sugared rind and add orange juice to the mixture, using one orange to every three or four lemons. Allow the mixture to stand for about one hour, stirring it occasionally, and then strain. Use at the rate of one-half pint per gallon of cream. The flavor is not added to the cream until it is nearly frozen to prevent curdling it. Use two pounds of sugar per gallon of cream.

Walnut Ice Cream. Use one gallon of cream, one and one-half pounds of sugar, two-thirds ounce vanilla extract and two-thirds pound of ground walnut meats. Freeze the same as vanilla ice cream.

Other Nut Ice Creams. Chestnut, filbert, hazelnut, pecan, peanut and almond ice creams may be prepared essentially the same as walnut ice cream.

Strawberry Ice Cream. Use one gallon of cream, one and one-half pounds of sugar and one-third quart of crushed strawberries. The fruit should be added to the cream after it is partially frozen so as not to curdle it or to have the fruit settle to the bottom.

Other Fruit Ice Creams. Cherry, raspberry, pineapple, peach, apricot, currant, grape and cranberry

ice creams are made the same as strawberry, except that the amount of sugar is varied according to the acidity of the fruit.

Packing Ice Cream. Remove the ice cream from the freezer while still in rather soft condition and put the same in packing cans which have been thoroughly chilled by having the ice and salt packed around them about ten minutes before receiving the ice cream.

Remove the brine and repack often enough to prevent melting. In the melting process the water separates and forms undesirable crystals when the cream is refrozen.

The Overrun or Swell. This refers to the excess of ice cream over cream. Anything that tends to incorporate and hold air in cream conduces to a large overrun. Thus excessive beating of the cream during freezing mixes a great deal of air with it, and hence increases the overrun. A high viscosity of the cream holds the air incorporated during freezing. Fresh separator cream has a low viscosity, that is, does not whip well, hence will not swell so much in freezing as cream that has been kept cold for twenty-four hours. Pasteurized cream also has a low viscosity, but this will improve by keeping the cream at a low temperature a number of hours before freezing.

An overrun of from 50 to 60 per cent. is about right.

CHAPTER XV

FANCY CHEESE

AMERICAN NEUFCHATEL CHEESE

Method of Manufacture. American Neufchatel cheese is made essentially as follows: Put a quart of milk in a suitable dish and add one drop of rennet extract (or rennin) or one-fourth junket tablet dissolved in cold water, thoroughly mix and allow to curdle. When thoroughly curdled, pour the curd into a cheese cloth bag and hang it up to drain. When all free moisture has drained away the cheese is salted just enough to make the salt perceptible to the taste. An ordinary room temperature (70 to 75° F.) should be maintained from the time the rennet extract is added until the cheese is finished.

Neufchatel cheese is usually sold in cylindrical packages being first wrapped in oiled or parchment paper and then in tin foil.

Keeping Quality. Neufchatel cheese is best when fresh. It should always be kept cold until consumed. Owing to its short keeping quality, it is difficult to buy this cheese in prime condition during the summer.

Composition and Food Value. Neufchatel cheese has an average composition as follows:

Water	50 per cent.
Butterfat	24 per cent.
Proteids	18 per cent.
Sugar, lactic acids, etc.	5 per cent.
Ash	3 per cent.
	100 per cent.

It will be noted that this cheese is rich in butterfat as well as in proteids, which makes it not only a more nutritious, but also a better balanced food, than cottage cheese. The presence of butterfat also increases its palatability and digestibility. When consumed fresh, Neufchatel is one of the most wholesome of all foods and possesses tonic value similar to that of sour milk. Its food value is practically double that of meat.

Quality Varies. A great deal of so-called Neufchatel cheese is made from skimmilk or partially skimmed milk. The food value and digestibility of the cheese is reduced, of course, by the removal of cream from the milk.

CREAM CHEESE

Cream cheese is made from milk to which enough cream has been added to bring the butterfat content to about ten per cent. The method of manufacture is the same as for Neufchatel cheese. In composition, digestibility and total food value it ranks well with Neufchatel cheese, but as a food it is rather unbalanced owing to the large proportion of butterfat as will be noted from the following composition:

Water	44 per cent.
Butterfat	40 per cent.
Proteids	12 per cent.
Sugar, lactic acid, etc.	3 per cent.
Ash	1 per cent.
	100 per cent.

Cream cheese is highly prized for its palatability. It is usually wrapped the same as Neufchatel cheese

and sold in rectangular packages holding about one-fourth of a pound.

CLUB CHEESE

This is an exceedingly palatable cheese and is made by the following simple process: Grind up with an ordinary meat grinder one pound of old well ripened Cheddar (American) cheese and mix with one-fifth pound of good butter. To aid in mixing the cheese and butter they should be run through the grinder together. A second grinding is necessary to give a perfect mixture free from lumps.

Club cheese is ideal for making sandwiches and is always best when fresh. Many persons who cannot readily digest Cheddar cheese, can eat Club cheese with impunity. This cheese is naturally very rich and should always be eaten with bread or crackers.

PIMENTO CHEESE

Pimento cheese is American Neufchatel cheese treated with ground red peppers. Usually from one-half to two-thirds ounce of the pepper is used per pound of Neufchatel cheese. The peppers are ground up fine by running them through a meat mincing machine, after which they are thoroughly mixed with the cheese. Pimento cheese is very popular with those who like spicy foods. It is packed in the same manner as Neufchatel cheese.

A pimento flavor can be given to Club cheese in the same manner as to Neufchatel cheese.

CHAPTER XVI

FANCY DAIRY DISHES

Junket. This wholesome and delicious dairy dish is made as follows: To a quart of sweet milk add sugar and flavoring to taste. Then heat the milk to about 90° F.; add one junket tablet dissolved in a tablespoonful of cold water; stir vigorously for a moment and then quickly pour into the dishes in which it is to be served. Keep warm until thoroughly curdled; then cool to 50° F. or below.

In place of the junket tablet, five drops of either rennin or rennet extract may be used. It is also desirable to pasteurize the milk, but care must be taken not to heat it above 150° F. as a higher temperature interferes with the subsequent curdling of the milk.

Junket furnishes one of the cheapest and most wholesome of dairy dishes, and is relished by nearly all people. Many persons with whom ordinary milk does not agree, can eat junket with impunity. The reason for this is that junket is consumed slowly and does not curdle in the stomach like milk.

Plain Bavarian Cream. This is one of the best substitutes for ice cream and is especially valuable where no ice can be had for making ice cream.

The method of making Bavarian cream is as follows: Thoroughly mix two egg yolks, three-fourths cup of sugar and a dash of salt. Stir slowly into this mixture three-fourths cup of scalding hot milk; heat in double boiler and stir until it begins to

thicken. Remove from heat and stir in one tablespoonful of best gelatin soaked in one-fourth cup of cold water. Next add flavoring, which may consist of one teaspoonful of vanilla extract or the juice of either one-half orange or one-fourth lemon; stir until gelatin is dissolved, and strain. When cold and beginning to set, whip a few minutes with egg beater and then stir in lightly one cup of whipped cream and pour mixture into a mold to harden.

Chocolate Bavarian Cream. Cook until smooth two ounces of melted chocolate, one-fourth cup of sugar and one-fourth cup of boiling water. Add this to the milk used for custard and proceed as in making plain Bavarian cream.

Charlotte Russe. Soak one tablespoonful of best gelatin in one-fourth cup of cold water and add one-third cup of scalding hot cream; stir in one-third cup of powdered sugar and one teaspoonful of vanilla extract. Next fold in three cups of whipped cream. Line mold with lady-fingers and pour mixture into it and chill.

Charlotte Russe, like the Bavarian cream, is a good substitute for ice cream, being very rich and palatable.

Devonshire Cream. Pour a quart of rich, fresh milk into a small double boiler and keep cold for about twelve hours to allow most of the cream to rise. Next gradually raise the temperature to about 180° F., being careful not to disturb the cream in any way. The temperature must be raised very

slowly, averaging about two degrees per minute. Keep hot for a number of hours, or until a stiff, crusty layer of cream has formed, and then cool. Remove the cream with a flat, perforated skimmer.

This cream has a very delicious flavor and is often eaten with bread, either sweetened or unsweetened. Cream prepared in this way is very thoroughly pasteurized and is therefore an entirely safe and wholesome food.

CHAPTER XVII

BUTTER AND OLEOMARGARINE

BUTTER

Food Value. Butter is composed principally of butterfat as seen from the following average composition:

Water	14 per cent.
Butterfat	83 per cent.
Proteids	1 per cent.
Salt	2 per cent.
	100 per cent.

As a rule butter is used for its palatability, that is, as a relish with other foods such as bread. Yet butter has also a very high food value. In this connection it should be remembered that a pound of fat has an energy or heat value equal to two and one-fourth pounds of either proteids or carbohydrates.

Compared with other fats such as lard, for example, butter seems rather expensive. But in placing a value upon butter it is necessary to give due consideration to its palatability and high degree of digestibility. The latter is especially important, particularly with invalids and persons suffering from weak digestion.

Process of Manufacture. The best butter is made by churning sour cream. The acidity adds flavor to the butter and also facilitates churning. Cream should contain about 30 per cent. butterfat and 0.5 per cent. acid when it enters the churn, and the temperature should be such as to bring butter in about

thirty-five minutes. The average churning temperature is about 58° F.

Churning consists in agitating the cream, which causes the microscopic fat globules to combine into masses visible in the churn as butter granules. When these granules are about the size of half a pea, the buttermilk is removed, the butter rinsed with cold water and salt added at the rate of about one ounce per pound of butter. The salt is thoroughly worked through the butter with a butter ladle, after which it is usually molded into rectangular "prints" weighing one pound.

Judging Butter. Butter is briefly judged or scored according to the following score card:

BUTTER SCORE CARD

	Perfect	Actual Score	Defect
Flavor	45		Light, Rancid, Fishy, Weedy, Stable, Unclean, High acid, Bitter
Texture	25		Poor grain, Cloudy brine, Too much brine, Greasy
Color	15		Mottled, wavy, White specks, Too high, Too light
Salt	10		Too much salt, Undissolved salt, Lacks salt
Package	5		Dirty, Poorly packed, Poorly nailed, Poorly lined
Total	100		

Flavor. Immediately after the sample of butter is withdrawn from the package it should be held under the nose to ascertain the quality of the aroma (flavor). Strictly speaking, flavor refers to the taste. But the use of the term flavor in butter judging usually includes both taste and aroma, the emphasis resting upon the latter.

It is difficult to describe an ideal butter flavor. It may perhaps be likened to the flavor of clean, well ripened cream.

Light flavor is generally due to churning cream too sweet. It may be due also to too much washing.

Rancid flavor is due chiefly to overripened cream. The age of the milk, cream and butter is also frequently the cause of rancidity. Good butter exposed to light and air at ordinary temperatures turns rancid in a very short time.

Weedy flavors are caused by cows feeding on weeds. Leeks or wild onions are frequently the cause of very serious trouble when cows have free access to them. The trouble may also be caused by exposing milk and cream to an atmosphere charged with objectionable odors.

Fishy flavor, according to L. A. Rogers, is due to oxidation which is favored by a high acid cream and overworking. The latter favors oxidation by increasing the amount of air in butter.

Stable flavor is caused by lack of cleanliness in milking, and by keeping milk too long in or near a dirty stable.

Unclean flavors are caused by dirty pails, strainers, cans and general uncleanliness in the care and handling of milk.

High acid flavor is due to oversoured cream.

Bitter flavor is caused by keeping cream too long at low temperatures.

Texture. An ideal texture is indicated by a somewhat granular appearance when a piece of butter is broken, an appearance quite similar to that of the broken ends of a steel rod.

Brine refers to the amount and character of the water in butter. It should be as clear as water and not present in such quantities as to run off the trier.

Too much brine is caused chiefly by underworking and by churning to small granules.

Cloudy brine is caused by churning at too high a temperature and also by granulating too coarse. Insufficient washing has a tendency to produce a cloudy brine.

Poor grain is caused by overworking and overchurning; also by too high temperatures in churning and working.

Greasy butter is caused by overworking or by handling at too high temperatures.

Color. The essential thing in color is to have it uniform. It should have a little deeper shade than that produced by June pasturage. Artificial coloring is therefore necessary.

Mottles are discolorations in butter caused by the uneven distribution of salt.

White specks are due either to curd particles in cream caused by overripening and lack of stirring during ripening, or to dried and hardened cream.

Salt. As with color, the essential thing with salt is to have it evenly worked through the butter and none of it should remain undissolved.

OLEOMARGARINE

Oleomargarine is a cheap substitute for butter and, on account of its cheapness, has found extensive sale in recent years. This product is also known as margarine or butterine.

The principal component of oleomargarine is beef fat. The lower grades contain a high percentage of cottonseed oil, while the best grades contain some butterfat.

Composition. In the twelfth report of the Government Census, the proportions of the raw materials which enter into the composition of the different grades of oleomargarine are given as follows:

HIGH GRADE OLEOMARGARINE

Oleo oil	100	pounds
Neutral lard	130	pounds
Butter	95	pounds
Salt	32	pounds
Color	00.5	pound

MEDIUM HIGH GRADE OLEOMARGARINE

Oleo oil	315	pounds
Neutral lard	500	pounds
Cream	280	pounds
Milk	280	pounds
Salt	120	pounds
Color	001.5	pounds

CHEAP GRADE OLEOMARGARINE

Oleo oil	495	pounds
Neutral lard	265	pounds
Cotton seed oil	315	pounds
Milk	255	pounds
Salt	120	pounds
Color	001.25	pounds

Digestibility. It has often been claimed that oleomargarine has all the merits possessed by genuine butter. This claim, however, does not seem to hold in respect to digestibility. Eminent chemists and food experts have long contended that no fat is equal to butterfat in digestibility. Both the physical and chemical properties of butterfat offer good reason for such belief. It has already been learned that butterfat exists in milk in an extremely finely divided condition and that one of the distinguishing characteristics of butterfat is its relatively high content of soluble fats or fatty acids. These conditions undoubtedly materially favor ease of digestion. A number of recent experiments add much positive evidence in support of this belief. It has been learned, for example, that butterfat is considerably more nutritious than such fats as lard oil and almond oil, and this superiority may be due to a higher degree of digestibility.

Color. Oleomargarine has naturally a whitish color, which is of value in distinguishing this product from butter. That some distinguishing mark is necessary is evinced by the fact that a great deal of oleomargarine in the past has been sold as butter. Indeed, deception has been practiced to such an extent that the federal government, for a number of years, has levied a heavy tax on every pound of oleomargarine colored in imitation of genuine butter. The result is that comparatively little colored oleomargarine is manufactured at the present time.

RENOVATED OR PROCESS BUTTER

This is old, stale, rancid butter which has been purified by forcing air currents through the melted fat and rechurning this mixed with milk or cream. To protect the consumer, the law requires that all butter which has undergone this treatment, be labeled Process or Renovated Butter. When packed in tubs, the label appears on the tub and the dealer may easily sell such butter to consumers as genuine butter. This furnishes an instance where butter put up in pound prints protects the consumer against an imitation product.

CHAPTER XVIII

COMMON CHEESE

CHEDDAR OR AMERICAN CHEESE

Formerly the term "Cheddar" was applied exclusively to what is now commonly known as American cheese. This cheese belongs to the so-called hard type of cheeses.

Briefly Cheddar cheese is made by precipitating the curd of milk by means of rennet extract. The curd is allowed to ferment until it has reached the right stage of moisture and acidity, when it is salted and then molded under heavy pressure. After pressing the cheese must undergo a long and careful curing or ripening process during which most of the insoluble curd is changed to soluble products.

Food Value. Cured Cheddar cheese has an average composition as follows:

Water	34 per cent.
Butterfat	34 per cent.
Proteids	26 per cent.
Sugar, etc.	2 per cent.
Ash	4 per cent.
	100 per cent.

From the composition it is seen that Cheddar cheese is an extremely rich food, one pound being equal to about two pounds of meat. It is a very economical substitute for meat. In the New York City penny lunches, cheese sandwiches furnished the largest amount of nutrients procurable for a penny.

Owing to its richness, this cheese is best adapted to the diet of people doing hard physical labor.

While in digestibility Cheddar cheese ranks well with other staple foods, it is well known that many people with weak stomachs cannot readily digest it. Under all conditions the cheese should be consumed with bulky foods, such as bread and crackers. When eaten alone or in connection with other rich foods, it has a tendency to produce constipation.

Important Qualities. Age is important in Cheddar cheese, because the real cheese flavor requires about six months to develop. Of even greater importance is the softening of the texture which also follows with age. A green or fresh cheese has a tough, curdy or rubbery texture which means that the casein is still insoluble and that the cheese is hard to digest. An ideal textured cheese is solid and waxy. A soft, pasty or sticky cheese is undesirable because it carries too much moisture. Corky cheese lacks moisture, while mealy or crumbly cheese is the result of too much acid and, like corky cheese, is undesirable.

Cheese is commonly judged on the basis of 45 points for flavor, 30 points for texture, 10 points for color and 15 points for finish and appearance.

BRICK AND SWISS CHEESE

These cheeses have essentially the same composition and food value as Cheddar cheese. But the methods of manufacture differ from the Cheddar process, which accounts for the difference in flavor and texture.

The texture of these cheeses must be mellow, waxy and plastic like that of Cheddar cheese, but more or less porous. In brick cheese small, irregular openings are characteristic, while large, smooth round holes are typical of the best Swiss cheese.

Swiss and brick cheese, like Cheddar, must undergo a thorough curing process to develop flavor and to break down the insoluble casein into soluble products.

CHAPTER XIX

PRODUCTION OF CLEAN WHOLESOME MILK

During the past few years a great campaign has been carried on in the interest of cleaner milk, and while great improvements have followed this, there is still a great deal of unsanitary milk placed upon

Figure 15—A sanitary cow stable

the market. The essential steps in securing clean, wholesome milk are briefly discussed in the following paragraphs.

Clean, Healthy Cows. The cow's health is of prime importance, and all milk from cows affected with any kind of disease should be rigidly excluded from the dairy.

Under ordinary conditions the cow is the main source of dirt in milk. The rubbing of the milker against her and the shaking of the udder during milking, will dislodge numerous dust particles and hair and these are liable to get into the milk unless special precautions are taken to keep them out.

When we consider that every dust particle and every hair that drops into the milk may add hundreds, thousands, or even millions of bacteria to it, we realize the importance of taking every precaution to guard against contamination from this source.

To keep cows as free as possible from loose hair, dust and manure particles, they should be carded and brushed regularly. This should be done at least an hour before milking to avoid dust. Five to ten minutes before the cow is milked her udder and flanks should be gently washed with clean, tepid water, by using a clean sponge or cloth. This will allow sufficient time for any adhering drops of water to drip off, at the same time it will keep the

Figure 16—Clean milking

udder and flanks sufficiently moist to prevent dislodgment of dust particles and hair during milking.

Cows should be kept only in clean, light, ventilated stables and must be turned out daily for exercise excepting in the most inclement weather.

The Milkers. Clothes which have been worn in the field are not suitable for milking purposes. Every milker should be provided with a clean suit consisting of cap, jacket and trousers. Milkers should also wash and dry their hands before milking, and, above all, keep them dry during milking.

Much disease transmitted through milk has had its origin in diseased milkers. The health of the milker is therefore a matter of prime importance.

Milk Vessels. All tin ware used in the handling of milk should be made with as few seams as pos-

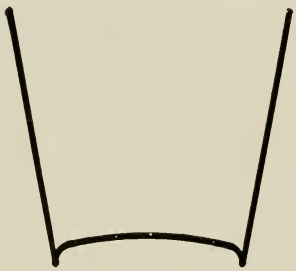

Figure 17
Unflushed seam

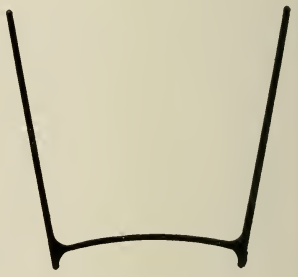

Figure 18
Flushed seam

sible. Wherever seams occur, they should be flushed with solder. Unflushed seams are difficult to clean and as a rule afford good breeding places for bacteria. Figure 17 illustrates the character of the

unflushed seam; Figure 18 shows a flushed seam which fully illustrates its value.

Figure 19 illustrates a modern sanitary milk pail. The value of a partially closed pail is evident from the reduced opening, which serves to keep out many bacteria and much dirt that would otherwise drop into the pail during milking.

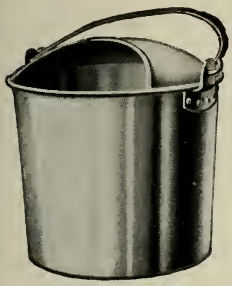

Figure 19
Covered milk pail

All utensils used in the handling of milk should be as nearly sterile as possible. A very desirable method of cleaning them is as follows:

First, rinse with warm or cold water. Second, scrub with moderately hot water containing some washing powder. The washing should be done with a brush rather than cloth because the bristles enter into crevices which the cloth cannot possibly reach. Furthermore, it is very difficult to keep the cloth clean. Third, after rinsing, scald thoroughly with steam or hot water. After scalding, the utensils should be inverted upon shelves without wiping and allowed to remain so until ready to use. This will leave the vessels in a practically sterile condition. Fourth, if it is possible to turn the inside of the vessels to the sun in a place where there is no dust, then it is desirable to expose the utensils during the day to the strong germicidal action of the direct sun's rays.

Flies. Flies not only constitute a prolific but also a dangerous source of milk contamination. These

pests visit places of the worst description and their presence in a dairy suggests a disregard for cleanliness. Of 414 flies examined, the average number of bacteria carried per fly was **one and a quarter millions.** Flies should be rigidly excluded from all places where they are apt to come in contact with the milk.

Other Conditions. Cows, of course, should have pure water and clean wholesome feed. Highly fermented brewers' grains and strong weeds are especially objectionable. The water of ponds and stagnant streams is also harmful. Not only is such water injurious to the health of cows, but by wading in it they become contaminated with numerous undesirable bacteria, some of which may later find their way into the milk.

Clean stables, clean barnyards and clean bedding must be provided to keep the cows clean.

The details considered in the production of clean, wholesome milk are shown in the following score card, prepared by the Official Dairy Instructor's Association and used by the federal government. In this score card 40 points are allowed for **equipment** and 60 points for **methods,** in producing milk.

SCORE CARD

EQUIPMENT	SCORE	
	Perfect	Allowed
COWS		
Health	6	
Apparently in good health....1		
If tested with tuberculin once a year and no tuberculosis is found, or if tested once in six months and all reacting animals removed....5		
(If tested only once a year and reacting animals found and removed, 2.)		
Comfort	2	
Bedding....1		
Temperature of stable....1		
Food (clean and wholesome)	2	
Water	2	
Clean and fresh....1		
Convenient and abundant....1		
STABLES		
Location of stable	2	
Well drained....1		
Free from contaminating surroundings....1		
Construction of stable	4	
Tight, sound floor and proper gutter....2		
Smooth, tight walls and ceiling....1		
Proper stall, tie and manger....1		
Light, four sq. ft. of glass per cow	4	
(Three sq. ft., 3; 2 sq. ft., 2; 1 sq. ft., 1. Deduct for uneven distribution.)		
Ventilation: Automatic system	3	
Adjustable windows....1		
Cubic feet of space for cow; 500 to 1,000 feet	3	
(Less than 500 ft., 2; less than 400 ft., 1; less than 300 ft., 0; over 1,000 ft., 0.)		
UTENSILS		
Construction and condition of utensils	1	
Water for cleaning	1	
(Clean, convenient and abundant.)		
Small-top milking pail	3	
Facilities for hot water or steam	1	
(Should be in milk house, not in kitchen.)		
Milk cooler	1	
Clean milking suits	1	
MILK ROOM		
Location of milk room	2	
Free from contaminating surroundings....1		
Convenient....1		
Construction of milk room	2	
Floor, walls and ceiling....1		
Light, ventilation, screens....1		
Total	40	

SCORE CARD—Continued

METHODS	SCORE	
	Perfect	Allowed
COWS		
Cleanliness of cows	8	
STABLES		
Cleanliness of stables	6	
Floor 2		
Walls 1		
Ceiling and ledges.....1		
Mangers and partitions.....1		
Windows 1		
Stable at milking time	6	
Barnyard clean and well drained	2	
Removal of manure daily to field or proper pit (To 50 feet from stable, 1.)	2	
MILK ROOM		
Cleanliness of milk room	3	
UTENSILS AND MILKING		
Care and cleanliness of utensils	8	
Thoroughly washed and sterilized in live steam for 30 minutes.....5		
(Thoroughly washed and placed over steam jet, 4; thoroughly washed and scalded with boiling water, 3; thoroughly washed, not scalded, 2.)		
Inverted in pure air 3		
Cleanliness of milking	9	
Clean, dry hands 3		
Udders washed and dried.....6		
(Udders cleaned with moist cloth, 4; cleaned with dry cloth at least 15 minutes before milking, 1.)		
HANDLING THE MILK		
Cleanliness of attendants	1	
Milk removed immediately from stable	2	
Prompt cooling (cooled immediately after milking each cow)	2	
Efficient cooling; below 50° F. (51° to 55°, 4; 56° to 60°, 2.)	5	
Storage below 50° F. (51° to 55°, 2; 56° to 60°, 1.)	3	
Transportation; iced in summer (For jacket or wet blanket, allow 2; dry blanket or covered wagon, 1.)	3	
Total	60	

Equipment.... + Methods.... = ...FINAL SCORE

NOTE 1.—If any filthy condition is found, particularly dirty utensils, the total score shall be limited to 49.

NOTE 2.—If the water is exposed to dangerous contamination or there is evidence of the presence of a dangerous disease in animals or attendants, the score shall be 0.

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